Effect of Handrail Use During Stair Climbing in OA Patients: A Pilot Study

Jenna Ackerman, Lindsey Remski, Russel Buffum, Abderrahman Ouattas and Brian A. Knarr,
Department of Biomechanics, University of Nebraska at Omaha, Omaha, NE 68182

INTRODUCTION

For the patients with osteoarthritis of the knee, stairs are commonly a difficult task and may be the first thing affect by osteoarthritis.[1] This population often employs altered strategies when they approach, ascend, and descend the stairs compared to a healthy population. Within 12 years, 80% of patients develop knee osteoarthritis in the contralateral limb.[2] Handrails play an important role by assisting with balance, control, and confidence, but their use needs to be assessed even further to fully understand how handrails impact the contralateral limb in osteoarthritic patients and how they may be integrated optimally into gait rehabilitation.

Purpose

The purpose of this study is to understand the underlying changes in biomechanics when osteoarthritis patients use handrails. As a first step, young healthy adults were used in this pilot study and given cues to mimic a patient with knee osteoarthritis.

MATERIAL/METHOD

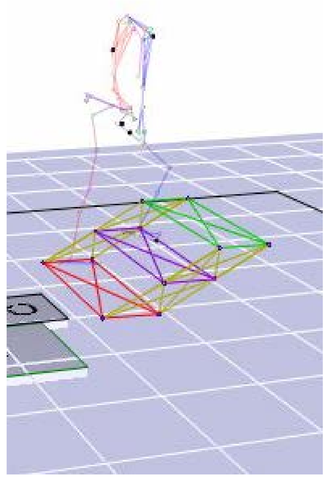
- Bertec instrumented stairs were used measure ground reaction forces on the stairs and handrails as healthy subjects approached, ascended, descended and continued walking off the stairs.
- Participants were verbally cued to simulate a patient with knee osteoarthritis.
- Ground reaction forces were analyzed leading up to the stairs, on the stairs, and walking away from the stairs using force plates at the base of the stairs and embedded in each stair. Instrumented handrails on the stairs were used to determine the forces produced when using one handrail at a self-selected amount.
- These were the targeted biomechanics used to emulate patients with knee osteoarthritis while ambulating stairs.
  - OA Patients Ascending: increase trunk flexion, decreased knee flexion and ankle dorsiflexion[3]
  - OA Patients Descending: decreased knee and hip joint angles[3]
- Each subject was randomly assigned an ‘involved’ knee before the data is collected.

METHOD

- This is an example of the cue used when the subject was mimicking OA while ascending the stairs using the left handrail. "When we tell you to go, walk up the stairs using the handrail on your left, placing one foot on each step. You may use the handrail however you like, but do not bend your involved knee as much as normal, as if it was injured. Stop facing forward once you reach the top and let go of the handrail."

Figure 1- Bertec Instrumented Staircase

Figure 2- Subject ascending the staircase as seen in Cortex



RESULTS

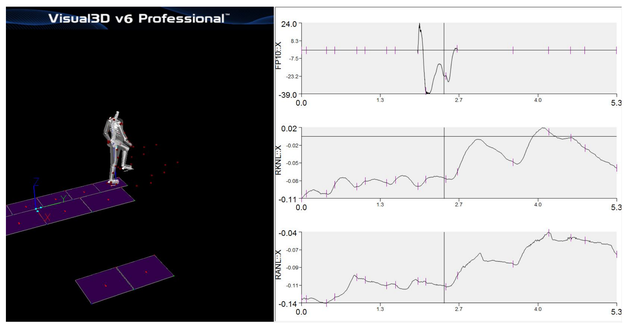


Figure 3- No Handrail self-selected use

REFERENCES

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3. Iijima H, Shimoura K, Aoyama T, Takahashi M (2018*). Gait & Posture*, 62, 191-201.

RESULTS

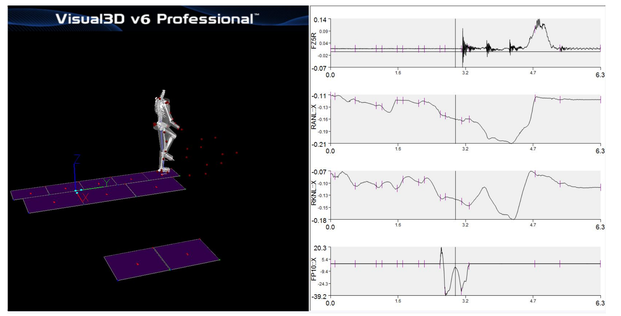

Figure 4- Left Handrail self-selected use

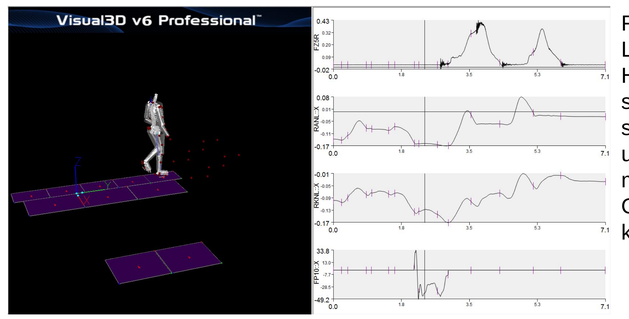

Figure 5- Left Handrail self-selected use mimicking OA in right knee

- These figures show the force for the force plate used in the preparatory step and angles for the right knee and right ankle in the preparatory step. Figure 4 and 5 also have the forces for left handrail.
- When comparing self-selected handrail use with no OA to self-selected handrail use while mimicking OA, the OA mimicking made the subject rely on the handrail more represented by the double peak.
- From when the subject used the left handrail normally, ‘uninjured’, to when they mimicked OA, maximum force on the left handrail increased from 210 N to 645 N.

Future Goal/Impact

We hypothesize that moments in the uninvolved knee will be maintained showing that the handrails are only reducing the forces at the involved knee. Understanding biomechanical implications of handrail use may allow for better clinical decision making and optimization of proper handrail technique for patients with knee osteoarthritis.

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